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Structure and Morphology of Poly(L-lactic acid) Fibers Studied by In-situ Synchrotron SAXS and WAXS

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Abstract: The structure and morphology of melt spun poly(L-lactic acid) (L-PLA) fibers were studied by in-situ synchrotron WAXS and SAXS on L-PLA single filaments under various thermal and stress conditions. From WAXS patterns, degree of crystallinity and orientation are strongly dependent on the take-up speed of spinning. The equatorial and meridional streaks on the corresponding SAXS patterns suggest the existence of axially and radially oriented nanovoids in fibers. When fibers are heated above the glass transition temperature of L-PLA (60°C), crystallization is observed from WAXS patterns. Two meridional lobes emerge on the corresponding SAXS patterns, suggesting the formation of lamella morphology along the fiber axis. As suggested by SAXS and WAXS patterns, crystallinity decreases as the fiber is cooled from 120°C to T_g. At constant temperatures above T_g, when strain is applied, WAXS patterns show the increase of degree of orientation of crystallites along the fiber axis and change in crystallinity. The nanovoids are orientated more and more along the fiber axis as suggested by the increase and decrease in intensity of the equatorial and meridional streaks, respectively, on the corresponding SAXS patterns.